

June 21, 1960

E. J. QUIRIN
DRILLING STRUCTURES

2,941,369

Filed Dec. 13, 1955

3 Sheets-Sheet 1

FIG. 1

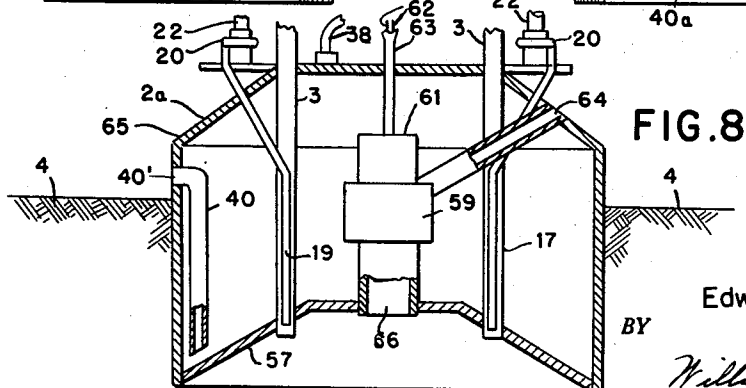
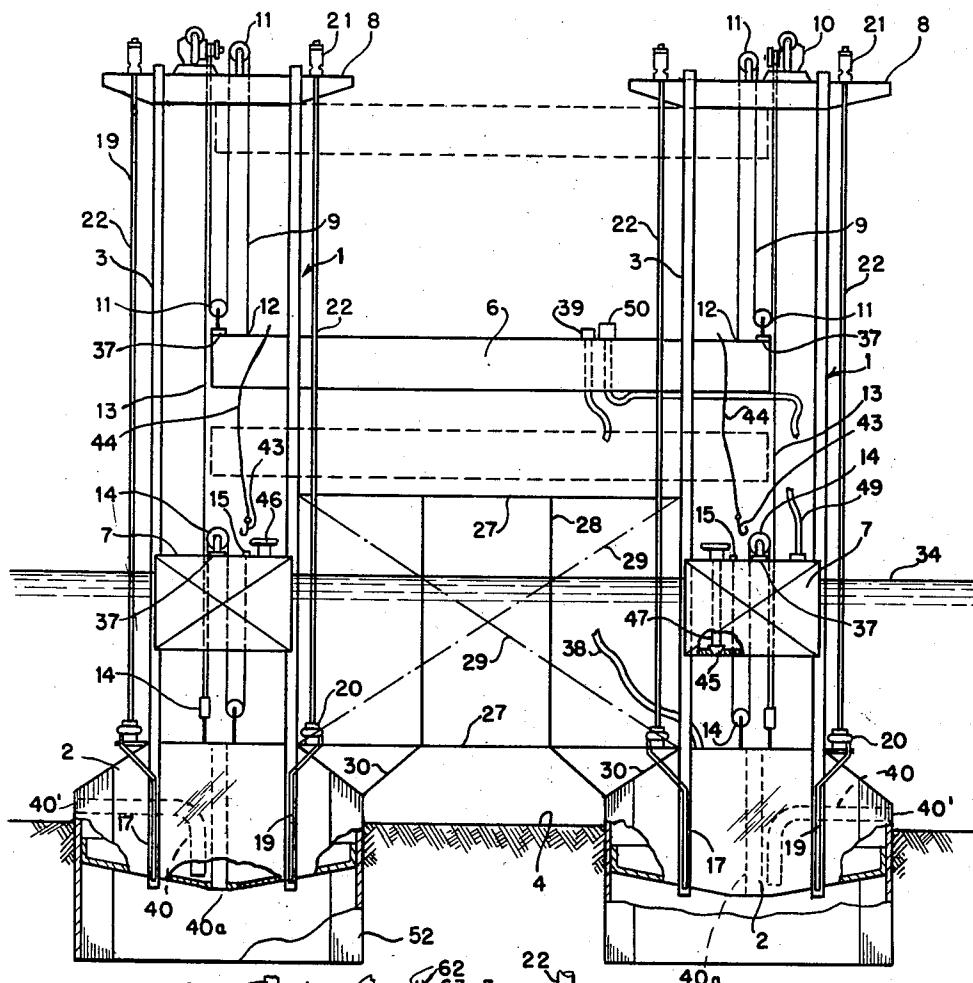


FIG. 8

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FIG. 2

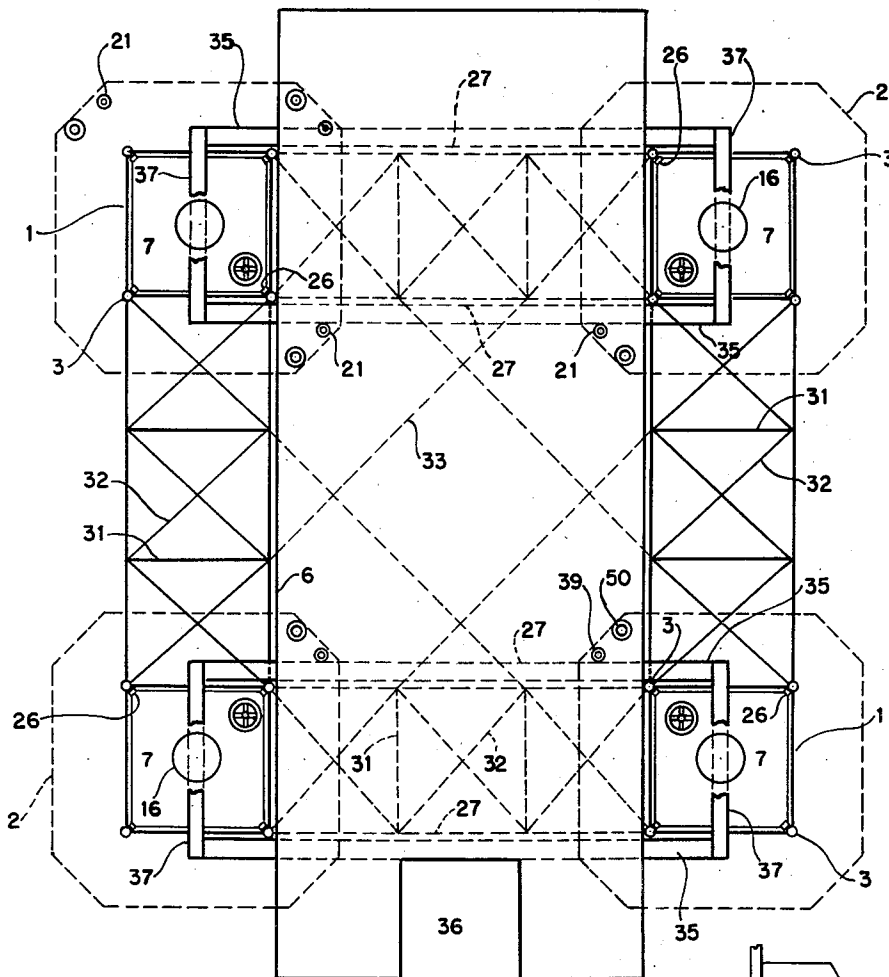


FIG. 3

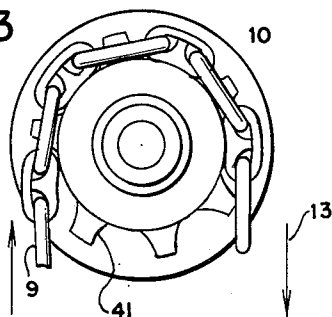
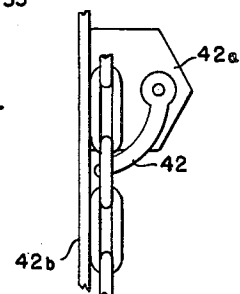


FIG. 4



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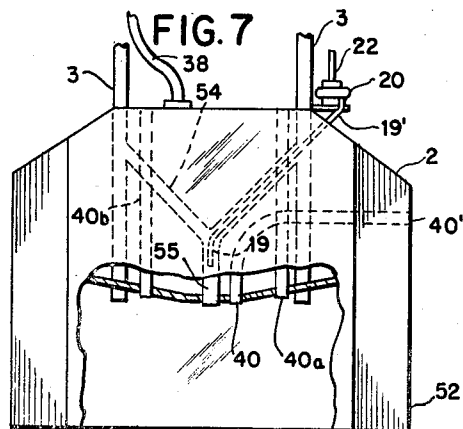
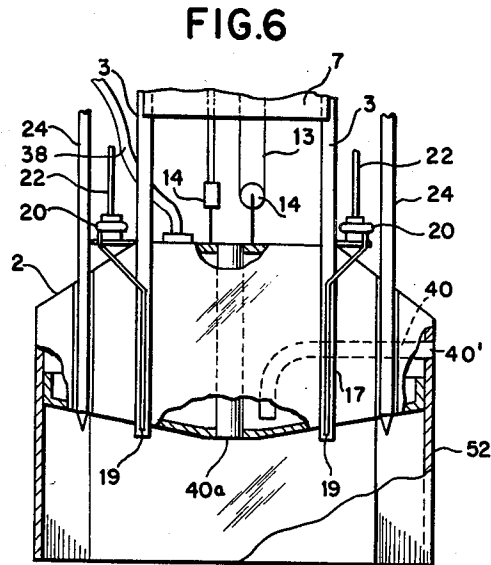
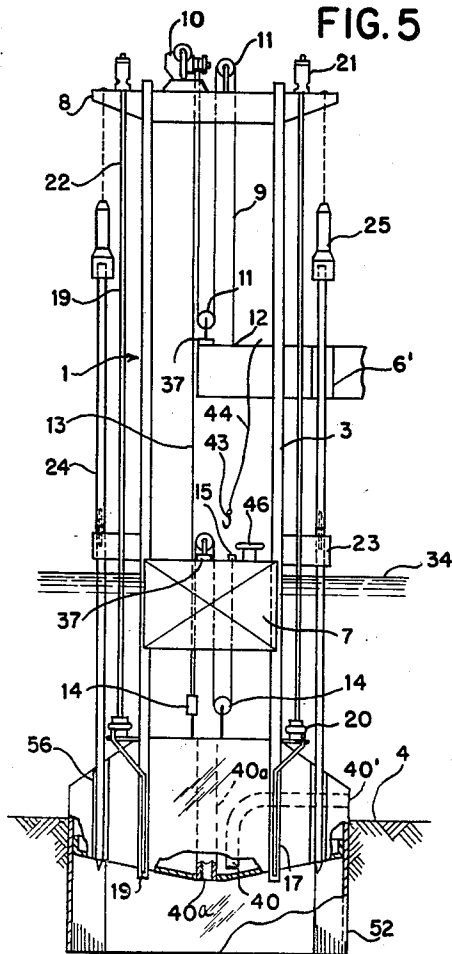
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DRILLING STRUCTURES

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4 Claims. (Cl. 61—46.5)

My invention is an improvement in structures to facilitate drilling into the earth; particularly a structure for supporting apparatus and equipment adapted to bore for oil under a body of water.

It is an important object of this invention to provide an installation which can be located in water of greater or less depth, and be sufficiently stable and independent of wave action to enable the required operations to be performed with efficiency and dispatch.

Another object is to provide a drilling structure having an adjustable working platform that can easily be lifted, and then held at a selected level as long as may be necessary.

A further object is to provide a drilling structure carrying buoyant and stabilizing members connected to the platform and cooperating therewith to locate the platform at proper distance above the surface of the water, where it can be maintained as long as operations are continued, and while the structure is shifted from one drilling site to another.

An additional object of this invention is to provide a structure having buoyant members with sufficient displacement to float the entire structure on the surface of a body of water, so that it can be conveniently towed to the site of intended use; and having connections by which the flooding of said members can be controlled to sink and embed them in the bottom under the water, and thus ensure a firm foundation for the structure while the work of drilling is in progress.

Yet a further object is to provide a drilling structure having the above mentioned buoyant members and stabilizing members, with connections so that when the working platform is once properly adjusted the stabilizing members can also be sunk below the surface, out of reach of wave action, and disposed so that they reinforce the effect of the flooded buoyant members in rendering the entire structure rigid and immovable on the foundation thus produced.

Still another object is to provide connections for the stabilizing and buoyant members of such a character that the buoyant members can be liberated from their embedded condition under the water and both the stabilizing and buoyant members then evacuated fully, so that the entire structure will again float free on the surface and can be towed to another site for further use; the stabilizing members then maintaining the platform above the surface of the water, so that the towing of the structure is facilitated.

Other objects and the nature and advantages of my invention are clearly set forth in the ensuing description and the novel characteristics are defined in the appended claims. On the drawing, some preferred embodiments of the structure are illustrated, but variations in many respects may be adopted without omission or material alteration of any of the features by which the invention is distinguished.

On said drawings:

Figure 1 is a side view of a structure according to my invention;

Figure 2 is a top plan thereof;

Figure 3 shows a detail of the machinery for raising the working platform in the structure;

Figure 4 shows another detail thereof;

Figure 5 shows a modified structure;

Figure 6 is an enlarged view of the lower end of said modified structure;

Figure 7 shows a modification of the construction of the buoyancy members; and

Figure 8 shows another modification of the buoyancy members.

The structure is generally square in plan, and comprises four upright towers 1, a tower being at each corner; and at the base or lower end of each is a hollow member in the shape of buoyant caisson 2. Rising from each caisson and affixed thereto are several columns 3, preferably four in number, each group of columns enclosing a square space within the compass thereof. The caissons 2 are to be anchored to the earth 4. Supported by the towers to move up or down, is an adjustable platform 6 which is connected to a buoyant stabilizing tank 7 in each of the towers 1. At the top of each tower is a deck 8 made fast to the upper ends of the columns 3. The columns 3 and decks 8 are parts of the towers 1 and the caissons are the bases or feet thereof. A length of chain 9 on each tower is joined to the platform 6 at one end and to a motor-driven winch 10 on the deck 8 of the tower at the other, passing from the winch down over an idle pulley 11 on the platform and up over another idle pulley 11 on the deck and down to the platform again, where it is fastened at a point 12. Another length of chain 13 in each tower runs from the winch 10 down through the stabilizing tank 7 in the tower to an idle pulley 14 mounted on the caisson 2, up to a similar idle pulley 14 on the same tank 7, down again to a third idle pulley 14 on the same caisson 2 and finally up to the said tank 7 again where it is made fast at a point 15. The stabilizing tanks or members 7 are hollow, but have tubular passages 16 extending through them from top to bottom in which the chains 13 can move as each tank 7 rises or falls. The winches operate the chains and the platform 6 and four hollow bodies or tanks 7 rise or fall in unison. There is of course a winch 10 with chains 9 and 13 on each tower; and these winches, as described below, merely take up or let out the chains 9 and 13.

The columns 3 pierce the caissons 2 from top to bottom and are sealed in the caissons 2, having no communication with the interiors thereof. The columns 3 are tubular and open through and through. The caissons are sunk far enough in the bottom 4 to be securely embedded by the action of streams of water delivered to pipes 19 in the lower portions 17 of the columns 3 by pumps 20 mounted on the caissons 2. The pumps are driven by motors 21 on the decks 8 connected to the pumps 20 by shafts 22. The jets delivered by the pipes 19 wash away the ground under the caissons and the towers thus settle into position at the drilling site in the well known way. For convenience the caissons are shown mostly in outline and the decks 8 with winches, motors and pulleys are omitted from Figure 2. The action of water jets from the pipes 19 is generally sufficient to embed the caissons at the location selected.

The columns 3 are at the corners of each tank 7, which are shown as square in cross section, and these corners have vertical liners or fenders 26 preferably of lignum vitae so that the tanks 7 can easily rise and fall in the towers 1. The towers are all connected by trusses containing two lower horizontal beams 27 at the level of the tops of the caissons 2 and similar beams 27 higher up; two such upper and two such lower beams extending between each pair of adjacent towers 1; and fixed at their ends to the columns 3; and lower beams 27 are connected

to the upper beams by vertical braces 28 between the towers and diagonal braces 29 joining one extremity of each upper beam 27, to the opposite extremity of a lower beam 27 directly beneath. Each lower beam 27 is united at the junction of each vertical brace 28 therewith by braces 30 to the adjacent caisson 2. Also the beams 27 are stiffened by horizontal trusses comprising transverse brace bars 31 and diagonal brace bars 32 connected to each pair of upper and lower beams 27 at the junctions of the vertical braces 28 therewith; and connected to all inside beams 27 at the junctions of all vertical braces 28 therewith are the diagonal horizontal braces 33, which join each upper and lower inside beam 27 along any two opposite sides of the structure to the upper and lower beams 27, respectively, of the other two sides of the structure. The top beams 27 are at such a height above the caissons 2 as to be close to or below the level of the water 34 when the structure rests on the bottom 4, because the platform 6 then is always a predetermined distance, such as 30 feet, for example, above the surface 34. The vertical fenders 28 of course engage the columns 3.

The platform as shown extends from one pair of towers 1 to the other, and projects at both ends. It can be lowered to be near the upper beams 27 and upper braces 33 and raised up almost to the level of the decks 8. Under the platforms near the ends are transverse lifting girders 35, a separate pair being at each end, the girders of each pair being far enough apart, with extremities projecting to flank each of the towers 1.

The platform 6 can therefore be lifted and lowered, with the towers 1 always between the ends of adjacent girders 35. These girders are fully shown in Figure 2 but the platform 6 appears diagrammatically on Figure 1, in lowered position.

One end of the platform has a central recess or bay 36. A derrick can be erected on a bridge on the platform 6 spanning the recess 36, to carry the drilling line that penetrates the ground. A mean 37 spans the girders 35 to mount the lower pulleys 11 and a similar beam on top of each tank 7 near passage 16 therein mounts the pulley 14 thereon, and the decks 3 will have openings through which the chains 9 and 13 may move up and down. For convenience, decks 8 are not shown in Figure 2.

As indicated on Figure 3, each winch 20 as it turns to pull up on its chain 9, allows the adjacent part of its other chain 13 to move down; and when the winch turns to let the platform move down, it will pull up on the chain 13 and the tanks 7 will move down. Each chain 9 may be connected adjacent the tops of the towers to the adjacent chain 13. When the structure is towed to the site, the hollow lower members or caissons 2 act as pontoons and the entire structure floats and moves along with the tops of the pontoons above the water surface. The pontoons are filled with air that can be pumped in through a hose or flexible pipe line 38, connected to the upper part of each pontoon and to a fixed coupling having a cap 39 on the deck of the platform 6. When the cap is removed air can be forced into each pontoon by connecting the coupling to a pump or reservoir, or allowed to escape through the line 38. In each pontoon is an open conduit 40 that leads from a point near the bottom to an opening or port 40' in the side of the pontoon near the top and below the water line when the entire structure is afloat. When the structure is in transit, water cannot enter the pontoons through the conduits 40 and ports 40', because of the pressure of the air in the pontoons, but when it arrives at the site to be explored, the lines 38 are opened and the air in the pontoons is released, and water will flow into them through the conduits 40 and ports 40', and they will submerge.

While the structure is being towed to the place of use, both the platform 6 and the tanks 7 are in lowermost position, the tanks 7 resting on the tops of the pontoons 2. When the air lines 38 are uncapped, water enters the caissons 2 and floods them and the entire structure then sinks till the caissons rest on the bottom 4. At the same time

the tanks 7, which are hollow and filled with air, are buoyed up by the water and exert a strong pull on all the chains 13, to lift the platform high enough to be out of reach of big waves. The winches are rotated to wind and unwind the chains thereon. Hence the winches and motors can be small and very little power is needed. In fact the motors for the winches 10 are employed merely to adjust the chains and keep the platform level. The caissons are settled and embedded in the ocean floor or bottom 4 by the weight of the structure and the excavating jets delivered by the pipes 19, loosening the earth under the caissons. The earth settles when the pumps are stopped.

The pumps 20 can be operated fast enough to fill the hollow columns 3, up to most of the height of the towers and then less power is needed at the motors 21 because the static head of the water in the columns 3 adds to the force of the jets at the lower ends of the pipes 19.

After the structure is sunk the tanks 7 must be submerged to avert disturbing wave action. The winches have projections 41 as on a sprocket wheel, to enter the links of the chains and are locked by dogs 42 engaging the chains so that the platform is maintained by the chains in elevated position. Then a workman descends by means of a rope or ladder (not shown) from the platform 6 to each tank 7. He places a hook 43 under the chain 13 at the pulley 14 on each tank, the hooks being attached to the ends of rope 44 made fast to the platform 6. Each workman then opens a valve 45 closing a port in the bottom of the tank, this being done by grasping and turning a knob 46 on a rod 47 which passes up through a threaded bearing in the top of the tank. The tanks now fill with water and sink till they reach the caissons 2. At this juncture the chains 13 are slack because of their disengagement from the uppermost pulleys 14 and do not hinder the tanks 7 as they sink below the water line 34, the chains having been pulled off the top pulleys by the ropes 44 and hooks 43.

Each tank 7 also has an air inlet line 49 leading from its top to a capped coupling 50 on the platform 6. This line will be opened when the tanks are to be submerged to release the air in the tanks and permit water to enter freely past the valves 45.

All the tanks and pontoons are so equipped but only one is so shown in Figure 1 at the right.

Whenever the drilling is finished or the structure is to be removed to another site, the pumps 20 are operated to force water into the bottom 4 below the caissons 2, to loosen the earth, and free the caissons. Air is forced through the pipe lines 38 to expel the water through the conduits 40 and ports 40' and the caissons again become buoyant pontoons and tend to rise to the surface. Air is also forced through the lines 49 to expel the water past the open valves 45 from the tanks 7, which also become buoyant, and the entire structure is soon afloat again. As soon as the tanks 7 come up, so that their tops are above water, the chains 13 are again disposed over the upper pulleys 14 and the valves 45 are closed. This operation can best be performed by causing the tanks 7 to rise before the caissons 2 are raised, and replacing the chains 13 upon the upper pulleys 14. The chains are then released from the dogs 42. Then as water is forced out of the caissons 2, and the caissons rise, the chains 13 allow the platform to sink to the dotted line position in Figure 1, but the tanks 7 hold the chains 9 and 13 taut through winches 10, and control the platform 6 as it descends; the tanks 7 then serving to some extent as counterweights for the platform 6. In its lowermost position the chains can again be locked by the dogs 42.

When the tanks 7 and caissons 2 are fully afloat, the tanks rest again on the caissons 2, so that the structure is stable, with the platform at the level shown by the dash lines in Figure 1, when under way.

The machinery for operating the drilling line will of course be mounted on the platform 6, with means for

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coupling it to the derrick which will be erected on a bridge spanning the recess 36 on the platform 6; and when the platform is raised and the tanks 7 are all submerged; only the piles 3 which form the towers, open on all sides, are exposed to the waves, and the combined lateral surface of the columns 3 present is small. Hence the structure will be steady in all kinds of weather and the risk of damage by storm is virtually eliminated.

Obviously the chains indicated at 9 and 13 may be continuous chains from the tanks 7 to the winches 10 and the platform 6. They pass over the winches and are held by the sprocket projections 41. With a continuous chain extending from the platform over the upper pulleys and to the winch, then down to the pulleys on the caisson and to the stabilizing tank just above each caisson, and fixed to this tank, several portions or sections shown at 9 and the several portions or sections shown at 13 are merely different sections or lengths of the same chain, as will be understood.

The structure above described is especially well adapted to be erected at sites where there is a relatively soft bottom under the water. Hence it is advantageous to extend the vertical sides of the caissons 2 downward below the underside of the caissons to form a rim or skirt 52 all around each caisson. The caissons then sink into the bottom more easily as the water discharged by the pumps 20 takes effect.

The platform may be so managed and operated that when the structure is floating on the surface the platform will be at a desired height above the water; and as the structure is sunk the buoyant action of the tanks will be so exerted as to raise and keep the platform at the same required distance above the water, even as it is moved towards the tops of the towers.

Each caisson 2 has a conduit 40a, open at both ends, going through from top to bottom and sealed from the interior, so that mud and water stirred up by the jets 19 can escape from the space surrounded by the rim 52.

If desired, the hollow columns or piles 3 can be joined in the caissons 2 by branch pipes 54 leading to a single nozzle 55 directly above the opening 40, and one or more pumps 20 may be connected to said nozzle by their discharge pipes 19'. See Figure 7. One pump might also be used with the nozzle 55, mounted centrally within or without each caisson. This modification shows two conduits like the conduit 40, one at each side of the central nozzle, indicated by numerals 40a and 40b.

Further, as shown in Figure 6, to anchor the caissons the towers can be equipped with guides 23 attached to the columns or piles 3, for stakes 24. These stakes pass through tubular guideways 56 in the caissons and are driven into the bottom under the water by weights 25, which can be raised and dropped by mechanism (not shown) on the platforms 8 to hit the upper ends of the stakes 24. The tubular guideways 56 are open at both ends but are of course sealed off at both ends from the interior of the caissons 2. The stakes 24 are jointed wherever necessary, as indicated on Figure 6 adjacent to the guides 23, and are driven below the water surface 34 far enough to be left in place and their upper ends to be below the rims 52 of the caissons when the structure is freed from its anchorage and floated, to be moved for use at another location. The sides of the platform have recesses 6' to clear the stakes 24.

The motors 21 for the pumps 20 are of course supplied with electric current through suitable conductors, and all the electric circuits for all motors can be controlled by switches and other necessary apparatus at a single panel on one of the platforms 8. The dog 42 may be mounted on a projection 42a, secured to a fixture 42b at any convenient point to engage the chains, as required.

In the modified construction of Figure 8, the caisson 2a has a concave bottom 57. On the interior is a pump 59, driven by an electric motor in a waterproof casing 61. The circuit wires 62 for the motor are encased in a tubu-

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lar sleeve 63 leading up to the deck 8. Of course there will be four such caissons, one at the foot of each tower 1. The pump discharges through a conduit 64 leading to an outlet port in the inclined peripheral portion 65 at the top of the caisson, and has an inlet pipe 66 opening through the bottom of the caisson. The pump 59 draws up water and mud loosened by the jets 19 and facilitates the sinking and embedding of the caissons on the bottom. This caisson may have a projecting skirt 52 if desired. This caisson 2a also has a pipe 40 inside extending from the lowest part of the bottom, which is closed except for the inlet pipe 66, up to the open port 40' in the side of the caisson 2a just below the water line thereof, when the entire structure is afloat. The caissons 2a always have some water in them and the lower end of the pipe 40 is immersed in such water. When the structure is afloat the air under pressure in the caissons 2a, forced in through the line 38, prevents water, as before, from flowing in through the port 40' and pipe 40; and thus the caissons 2a are kept buoyant. To sink the structure the compressed air in the caissons 2a is allowed to escape through the line 38, water then enters the caissons 2a by way of the ports 40' and pipes 40, and the structure goes down till the caissons 2a rest on the bottom, where they are embedded by the action of the jets of water emitted by the pipes 19 as above described.

The pipes 40 in all the caissons have portions vertical above their lower ends which are always covered by water at a low depth in the caissons. Hence the water cannot enter the caissons when there is sufficient pressure in them.

The structure illustrated in part on Figure 5 will also have air connections including the lines 38 and 49, but are not shown in this view.

Having described my invention, what I believe to be new is:

1. A structure to support equipment for boring into the earth under a body of water, comprising upright connected towers, means at the lower ends of each tower for securing said structure to the earth under the water, a platform movably suspended on said structure above said securing means and extending between the towers, vertically movable buoyant stabilizing tanks one at each tower between said securing means thereat and the platform, chains one at each tower, each chain comprising sections joined end to end, each chain having a section affixed at one end to an adjacent tank and leading from said adjacent tank to said securing means at the adjacent tower, and movably engaging the securing means at said adjacent tower, and then passing from said securing means to a point on the adjacent tower above said platform, and at least one other section fixed to said platform and leading from the platform to said point, and power means at each of said points operatively engaging said last-named two sections, said power means and the buoyancy of each tank being sufficient to raise the platform above the water when the towers are lowered into the water.

2. A structure to support equipment for boring into the earth under a body of water, comprising upright connected towers, a member at the lower end of each tower for securing said structure to the earth under the water, a platform movably secured to said structure above said members and extending between said towers; vertically movable buoyant stabilizing tanks slidably mounted on said structure, one between each of said members and said platform, a chain at each tower, each chain comprising sections joined end to end, a section of each chain having its lower end affixed to the platform and extending upward to a point on each tower, rotary power driven means at said point on each tower operatively engaging the sections thereat, the remaining sections of each chain being affixed to one of said tanks and movably engaging the member below it and extending up to said point and likewise operatively engaged by said power means, so that upward movement of the tanks tensions the chains, said power means and the buoyancy of said tanks as said members are sub-

merged being then sufficient to cause the chains to lift the platform above the surface of the water.

3. A structure to support equipment for boring into the earth under a body of water, comprising upright connected towers, a member at the lower end of each tower for securing said structure to the earth under the water, a platform movably secured to said structure above said members and extending between said towers; vertically movable buoyant stabilizing tanks slidably mounted on said structure, one between each of said members and said platform, a chain at each tower, each chain comprising sections joined end to end, one section of each chain having its lower end affixed to the platform and extending upward to a point on each tower, rotary power driven means at said point on each tower operatively engaging said sections thereat, the remaining sections of each chain being affixed to one of said tanks and movably engaging the member below it and extending upward to said point, and operatively engaged by said power means thereat, so that upward movement of the tanks tensions the chains, said power means and the buoyancy of said tanks as said members are submerged being then sufficient to cause the chains to lift the platform above the surface of the water, and a member at a fixed point adjacent each of said towers having means for locking said power means and holding the platform in desired position.

4. A structure to support equipment for boring into the earth under a body of water, comprising upright connected towers, means at the lower ends of each of said towers for securing said structure to the earth under the water, a platform movably suspended on said structure above said securing means and extending between the towers, a vertically movable buoyant stabilizing tank at each tower between said securing means thereat and the

platform, chains one at each tower, said chains comprising sections joined end to end, each chain having a section affixed at one end to an adjacent tank, and leading from said adjacent tank to said securing means at the adjacent tower and movably engaging said securing means at said adjacent tower, and then passing from said securing means to a point on the adjacent tower above said platform, and at least one other section fixed at one end to the platform and leading from the platform to said point, and power means at each of said points operatively engaging said last-named sections thereat, said power means and the buoyancy of each tank being sufficient to raise the platform above the water when the towers are lowered into the water, means for admitting water to each of said securing means and tanks and air connections at the top of the securing means and tanks to expel said water.

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